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THE ROSE APHIS.[1]

By H. M. Russell,

Entomological Assistant, Truck Crop and Stored Product Insect Investigations.

INTRODUCTION.

Because of its beauty, and its hardiness as an outdoor plant, the rose has long been one of the most popular ornamental flowers in this country. Yet in spite of the appreciation given it the blossoms and young foliage are frequently permitted to suffer great damage from the rose aphis (*Macrosiphum rosæ* L.), whereas a few minutes' attention on the part of the owner each week would remedy the injury and greatly increase the beauty of the bloom and foliage. This common rose pest was first described by Linnæus [2] in 1735, and since that time has often been mentioned in systematic works by both European and American writers. However, the writer has seen no account of it in American entomological publications in which the life history, habits, or control have been treated with anything approaching completeness. The writer, therefore, in 1910, while stationed at Los Angeles and under the direction of Dr. F. H. Chittenden, began a study of the life history and habits of the rose aphis in its occurrence on the outdoor roses so largely grown in southern California. At a later period the work was carried on to some extent in Washington, D. C. While this study is still incomplete, enough has been learned to give the rose lover a fair understanding of the habits of this insect and of the means for controlling it.

RECENT RECORDS.

During the fall and winter of 1909 and the spring of 1910 the writer found the rose aphis attacking roses and causing extensive damage to the buds and blossoms throughout the city and in the vicinity of Los Angeles. On October 21, 1909, when first observed,

[1] This bulletin is of interest to rose growers everywhere.

[2] Linnæus, C., Systema Natur., ed. 12, vol. 1, pt. 2, p. 734, 1767.

this insect had become quite common, and many of the buds were covered with the females and young. Examination of surrounding localities disclosed the same conditions of infestation. The aphides increased rapidly until the cold weather in December checked, although it did not entirely stop, their reproduction and growth. In January, warmer weather again prevailing, the rosebushes began to grow rapidly, and the rose aphis became very abundant on the tender stems and buds. It continued abundant and developed rapidly during the months of February and March, although syrphus-fly larvæ devoured thousands. Early in April, however, there occurred several very warm days when the temperature rose to 100° or 101° F., and immediately the numbers of aphides were greatly reduced. Afterwards the aphis occurred scatteringly on the roses and caused very little damage. This was due in part to extreme heat and the work of parasitic and predaceous enemies, and to the fact that in June the roses became more or less dormant and ceased active growth for some weeks. By the middle of August the rosebushes had resumed active growth, and this insect again began to increase rapidly and to cause damage, continuing to multiply and injure the roses until October 1, 1910, when observations ceased.

At Washington, D. C., during October and November, 1912, this aphis was very abundant and injurious to roses grown in the yards and gardens of the city. But by November 29 only a few aphides remained on the plants, although these persisted as late as December 16.

DESCRIPTION.[1]

The rose aphis occurs in two forms, one in which the body is of a pinkish color and the other in which the pink is replaced by bright green. Both forms may be present on the same bush or twig, and in some cases all on one bush may be green and all on another near it pink. It would appear from the writer's observations that the green aphides are much more abundant during the cooler months than the pink forms.

The winged female (fig. 1, *a*) has a pear-shaped body which in one form is pinkish and in the other bright green. The thorax is largely black, apparently deeper black in the green form, and there is a row of black spots on either side of the abdomen. These colors may vary slightly in shade. The antennæ, cornicles, ends of femora, and the tarsi are black, while the other parts of the legs are whitish. In both pink and green forms, however, the head may be entirely black, and the black antennæ and cornicles may be hyaline at the tips. The

[1] Another aphis commonly found on the rose is known as the small green rose aphis (*Myzus rosarum* Walk.), but this can be distinguished by its smaller size and by the fact that it has only a green form. This species is shown in figure 2, in both winged state (*a*) and wingless state (*b*) with many details of structure. This aphis will yield to the same treatments as the common rose aphis.

eyes are dark red, the cauda is yellowish, and the veins of the wings are light yellow. The legs, antennæ, and cornicles are very long and slender, the antennæ longer than the body. The length of the body is about one-twelfth of an inch (2.5 mm.) from the front to the tip of the cauda and the length of wing about one-sixth of an inch (4.2 mm.).

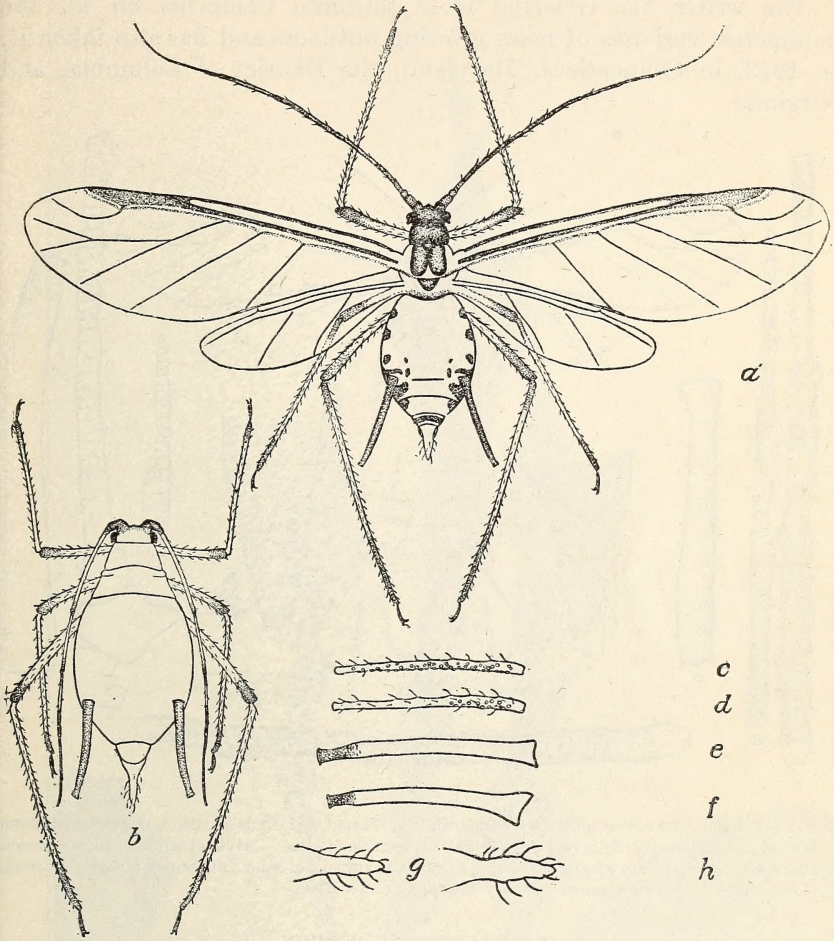


FIG. 1.—The rose aphis (*Macrosiphum rosæ*): *a*, Winged viviparous female; *b*, wingless viviparous female; *c*, *e*, *g*, third antennal article, cornicle, and style, respectively, of winged female; *d*, *f*, *h*, same of wingless female. Greatly enlarged. (After Essig.)

In the wingless female, also (fig. 1, *b*), the body is pear shaped, more or less blunted at the posterior end, and pinkish or bright green in color. The eyes are red. The antennæ are as long as the body and very light green. The cornicles and legs are long and slender and light green. The length of the body is about one-twelfth of an inch (2.5 mm.).

DISTRIBUTION.

The rose aphis is distributed over the entire United States, having been recorded from Massachusetts, New Jersey, Illinois, Iowa, Minnesota, Colorado, and California. It also occurs in Europe, from which country it was first described.

The writer has collected it in southern California on all the commoner varieties of roses growing outdoors and has also taken it, in 1913, in Connecticut, Maryland, the District of Columbia, and Virginia.

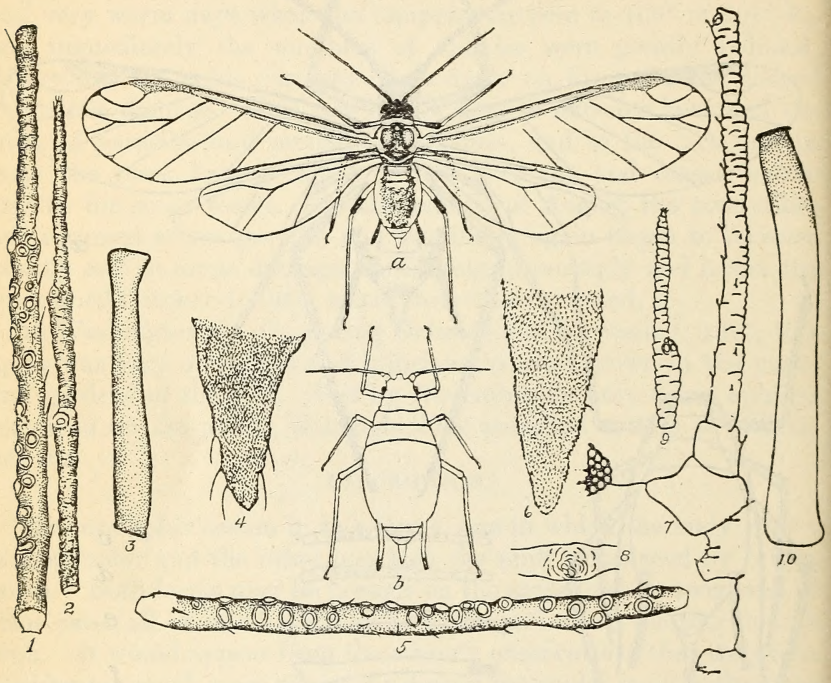
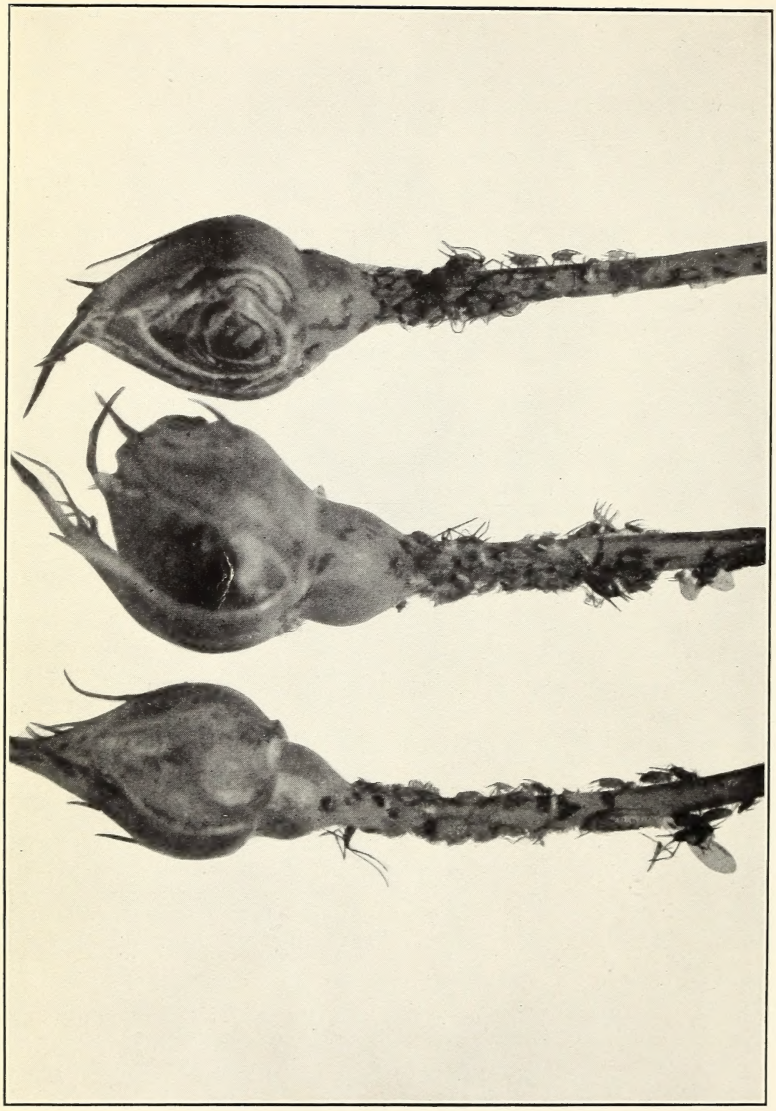


FIG. 2.—The small green rose aphis (*Myzus rosarum*): *a*, Winged viviparous female; *b*, wingless viviparous female; *1*, *2*, antennal articles of winged female; *3*, cornicle of same; *4*, style of same; *5*, third antennal article of same; *6*, style of wingless female; *7*, *9*, front and antenna of same; *10*, cornicle of same; *8*, process of sixth antennal article of same. Greatly enlarged. (After Essig.)

CHARACTER OF INJURY.

This insect, like all aphides or plant-lice, obtains its food by suction. The slender beak with which it is furnished is inserted into the plant attacked, and through this the plant juices are taken up. The rose aphis in feeding chooses the tender and growing shoots and flower buds or the young unfolding leaves, and by feeding in large numbers checks the growth, the leaves and flowers being curled or distorted and prevented from attaining their perfect form. (Pls. I, II.)

ROSE BUDS SHOWING INJURY BY THE ROSE APHIS (MACROSIPHUM ROSAE). ENLARGED. (ORIGINAL.)



ROSE BUDS SHOWING COLONIES OF THE ROSE APHIS (MACROSIPHUM ROSAE). ENLARGED. (ORIGINAL.)

Because of the feeding of this rapidly reproducing insect, the flowers may be largely spoiled for decoration, or, since the rose aphis, like all aphides, secretes a sweet sticky liquid called honeydew, the appearance of the foliage may be ruined because of the sooty mold that develops where this honeydew has collected.

HABITS.

About the time the wingless females become ready to reproduce they leave the parent colony and crawl or migrate to various parts of the rosebush. Upon finding a growing twig or bud, the female settles down with the head pointed toward the ground and begins to feed. In a day or two she begins to give birth to young, which ordinarily range themselves close together around the tender bud or stem behind the adult, and with the heads all pointing downward begin feeding. (Pl. II.) As the stem or bud becomes crowded many move out until the flower itself is covered with them. As the aphides continue feeding a large amount of honeydew is produced which falls to the leaves beneath, causing a disagreeable stickiness on the leaf, which either becomes covered with dust or black from sooty mold.

A very slight jar causes the aphides to let go with one pair of legs, and all begin to twitch from side to side on the remaining four legs until quiet is restored, while a severe jar causes many to fall to the ground. A number of the young develop wings, and when mature they fly to other buds and form new colonies.

When the nymph changes to the winged form the skin splits along the dorsum and the adult crawls slowly out. When newly transformed the adult is light reddish or green in color, with antennæ, beak, legs, and cornicles whitish or hyaline, and the wings, which are also white in color, appear as little sacks on the back. In about 20 minutes the wings become fully expanded, and two days later the aphis has the colors of the mature insect.

LIFE HISTORY AND REPRODUCTION IN CALIFORNIA.

In a climate as mild as that of southern California this insect reproduces continuously throughout the year and undoubtedly is capable of reproducing asexually and viviparously for an extended period. While under observation it has been found giving birth to living young throughout the entire year, and the writer has been unable to find eggs during the same period. It may be that in a climate such as exists in that part of the country, where very cold weather does not occur and where the roses continue to grow all

winter, sexual forms and eggs of this species are not produced, at least until parthenogenetic reproduction causes deterioration.[1]

In other parts of this country where the winter conditions are more severe the rose aphis passes the winter in the egg stage. At Washington, D. C., on November 29, 1912, the writer found a few eggs of this species laid on the twigs of rosebushes. These small, oval, shining black eggs were fastened to the sides of dormant buds.

Buckton [2] described the eggs as follows:

> The eggs are at first yellow, but subsequently they become black by reason of certain changes shown by Balbiani to result from fecundation. Previous to this time the outer coats are sufficiently thin and transparent to allow the process of segmentation to be observed.
>
> Notwithstanding the great size of the ovum the female may carry five or more. These, however, are not equally large, but are found to vary in bulk as they approximate maturity and the time for expulsion.

In California during the fall and spring, while the rose shoots are growing vigorously and producing much tender growth, the rose aphis reproduces very rapidly. During the summer, however, the rate of reproduction seems to be much reduced, and, owing to the attack of natural enemies, this insect does not greatly increase. In the winter the time of development is lengthened and the rate of reproduction is considerably less.

During the months from October, 1909, to March 10, 1910, the author endeavored to ascertain the number of young produced and the average rate of reproduction under normal conditions. This was done by marking rose twigs having a single female and, after examining them every other day, removing all the young born at that time. Thus the aphides were exposed to temperature, rain, and all other natural conditions which might influence them. Under this method many females were knocked from the bushes and lost, but as this would occur naturally it demonstrates fairly well the average rate of reproduction, if not the maximum, under the conditions most favorable for the adult. These records have all been included in Table I.

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[1] B. M. Lelong, in the Report of the State Board of Horticulture for California, for 1889, page 213, states that "Kyber, in 1815, has had the rose aphis producing young for four years. From his carefully conducted experiments and from corresponding ones made by other naturalists a law has been educed, which we dare not destroy, 'that under certain circumstances, a female aphis may without coupling continue *propagating to infinity*, provided that the necessary conditions for the development of the young—food and heat—are not wanting.'"

[2] Buckton, G. B., Monograph of the British Aphides, vol. 1, p. 107–108, 1875.

TABLE I.—*Reproduction and development of the rose aphis, Macrosiphum rosae, in southern California, 1909–10.*

Date of birth of female unknown; gave birth to first young Oct. 20, 1909:

	Number of young.
Oct. 20	4
21	5
22	5
23	7
24	5
25	7
26	(1)
Total	33
Average per day	5½

Date of birth of female unknown; date of birth of first young unknown:

Nov. 3	6
4	4
5	2
7	4
8	(1)
Total	16
Average per day	3+

Female born Nov. 18, 1909; gave birth to first young Dec. 6, 1909:[2]

Dec. 6	1
8	5
10–11	6
12	3
13–14	4
15–16	9
17	2
18–19	3
20–21	6
22–23	5
25	2
28	(3)
Total	46
Average per day	2½

Date of birth of winged female, red form, unknown; date of birth of first young unknown:

Nov. 18	[4]18
19	3
20	5
21–22	12
23	10
24	(1)
Total	48
Average per day, about	6

Date of birth of female unknown; gave birth to first young Nov. 19, 1909:

	Number of young.
Nov. 19	2
20	2
21–22	4
23	4
24	2
25	2
26	(?[5])
27	2
28	2
29	2
30	(1)
Total	22
Average per day	2

Date of birth of wingless female, green form, unknown; gave birth to first young Nov. 19, 1909:

Nov. 19	2
20	5
21–22	6
23	5
24	4
25	3
26	(?[5])
27	4
28	(1)
Total	29
Average per day	3+

Wingless female born Nov. 18, 1909; gave birth to first young Dec. 6, 1909:[2]

Dec. 7–8	3
8	(5)
10–11	3
13	7
15–16	7
17	3
18–19	6
20	1
21	(3)
Total	30
Average per day	2

[1] Aphis lost.
[2] Period from birth to reproduction, 18 days.
[3] Aphis dead.
[4] Up to date.
[5] Rain.

TABLE I.—*Reproduction and development of the rose aphis, Macrosiphum rosae, in southern California, 1909–10*—Continued.

Date of birth of female unknown; gave birth to first young Jan. 3, 1910:	Number of young.
Jan. 3	2
4	2
6	9
8	(1)
Total	13
Average per day	3

Winged female, red form; gave birth to first young Mar. 3, 1910:	
Mar. 3	5
4	5
5	9
6	5
7	5
8	3
9	(1)
Total	32
Average per day	5⅓
Mar. 7	5
8	5
9	7
10	(1)
Total	17
Average per day	5⅔

Two females were observed that produced 30 and 40 young, respectively, after which they died under normal conditions. They produced young on an average of 2 and 2½ per day for 15 and 20 days, respectively, during the month of December. Other females observed during the same period, but lost possibly before reproduction was completed, gave birth to from 15 to 45 young at an average of 3½ per day. Two females observed in the month of March, however, produced young at the rate of 5⅓ and 5⅔ a day, showing quite plainly how the reproduction was accelerated during the prevalence of warmer temperatures. Two females in October reproduced young at the rate of 5½ a day for 6 days, or until lost.

From these observations it may be said that this insect is able to reproduce for at least 20 days during the winter in southern California and to give birth to as many as 45 young, while in the warmer seasons the number of young is probably greater and the period of reproduction is considerably shorter. The reproduction experiments were too few in number to justify making any statements more generalized than these.

LIFE HISTORY AND REPRODUCTION IN THE GREENHOUSE.

During the fall of 1912 the rose aphis was under the direct observation of the writer in the insectary greenhouse at Washington, D. C., and the life cycle was observed for a few individuals.

A wingless female born October 10 matured and gave birth to young on October 19, or in 9 days. During the next 7 days she gave birth to 45 young, or an average of 6⅜ per day.

[1] Aphis lost.

Of four other aphides, born on October 10, two became adult and gave birth to young on October 22, or in 11 days, while another required 12 days, and the fourth 13 days.

Another aphis was born on October 19 and emerged as a winged female on November 3, reaching maturity in 15 days. This insect lived as an adult for 17 days and gave birth to living young for 14 days. During this time she gave birth to 87 young, or an average of $6\frac{3}{14}$ per day. During this time the average mean temperature was 67° F.

LIFE CYCLE IN CALIFORNIA.

During the winter months of 1909–10 the life cycle was observed in California in a number of cases. Aphides born on the 18th of November became adult wingless females and began to reproduce young in from 15 to 18 days, and in two cases the offspring of these same insects became mature and began to reproduce in from 18 days for wingless females to 21 days for winged females. Aphides born November 26 emerged from nymphal skins as winged adults in from 23 to 25 days. Thus the wingless forms developed in all cases from 7 to 8 days sooner than winged forms.

This was the maximum life cycle, and during the rest of the year the growth must have been much faster, but observations were not made owing to press of other matters.

GENERATIONS.

Taking 25 days as a maximum, this would allow more than 12 generations annually, but with the shorter life cycle required during the warmer part of the year this number must be exceeded by at least 7 or 8 generations. In greenhouses there are probably 25 to 30 generations in a year.

LONGEVITY.

During the winter these insects are long lived for such delicate creatures. One lived under the direct observation of the writer for 40 days and another for 33 days. Probably this is longer than for the same insect the rest of the year.

NATURAL CONTROL.

RAINS.

In southern California the rainy season extends from about October 1 to May or June. Usually before the rains set in the weather becomes cooler, but the rains are not as a rule hard and dashing, as are those so fatal to aphides in the East, and this apparently explains their slight effects as observed on the rose aphis. Undoubtedly some are washed away and destroyed by rain, but not to the extent occurring in the East, although reproduction seems to be greatly checked during a rainstorm. In the East this insect is many times nearly exterminated by a hard, dashing rain.

HEAT.

During the early part of April, 1910, when the aphis was very abundant on the roses throughout the entire city of Los Angeles, three or four very hot days occurred during which the temperature rose as high as 100° F., and within a day or two thereafter the numbers of this aphis had become very much diminished. After this it did not seem to occur in large numbers again until about the middle of August.

BIRDS.

On March 19, 1910, the writer, with field glasses, watched a white-crowned sparrow (*Zonotrichia leucophrys leucophrys*) on a rosebush, 10 feet away, eating the rose aphides as fast as it could pick them from the bush. This was continued for fully 10 minutes, during which time many hundreds must have been eaten, as the plant was almost cleaned up by this bird.

On March 30, 1910, a California house finch (*Carpodacus mexicanu frontalis*) was observed by the writer eating this aphis from a rosebush for fully 15 minutes.

PARASITIC INSECT ENEMIES.

There are many different species of parasitic insect enemies that attack aphides, and some of these will attack the rose aphis. On June 13, 1910, many specimens of *Macrosiphum rosæ* were found which showed signs of parasitism by an undetermined insect. These aphides were rounded and fastened to the underside of the rose leaves. The parasite when full grown had killed the host and, cutting its way out beneath the body, spun a tiny cocoon between it and the leaf. Unfortunately all of the parasites failed to emerge. While the parasite was not rare, at least during the past year, it did not seem to check the rose aphis to any extent.

Ephedrus incompletus Prov., a braconid, was reared by the writer from this aphis at Washington, D. C., in 1912.

PREDACEOUS INSECTS.

Among the predaceous enemies the larvæ of syrphus flies and lady-birds were observed feeding on the rose aphis, and without a doubt the most important check to this insect in 1910 was due to the larvæ of syrphus flies. While these did not seem able to clear a plant altogether, still it was many times observed that strong thriving colonies of 50 to 60 aphides or more would be reduced by these insects in one or two days to a mere scattering here and there. During the year 1910 five different species of Syrphidæ were reared from larvæ feeding on *Macrosiphum rosæ*. These were *Syrphus ribesii* L. (fig. 3), *Syrphus opinator* O. S., *Allograpta fracta* O. S., *Eupeodes volucris* O. S. (fig. 4), and *Lasiophthicus pyrasti* L.

The adults of all these species seemed to have similar habits. They flew swiftly from twig to twig and hovered over them in the bright sunlight, the wings moving with extreme rapidity, always with a distinct humming sound. From time to time they alighted on the twigs or leaves and searched here and there for colonies of the aphis. The abdomen was generally kept in throbbing motion, and when an egg was to be laid a long slender ovipositor was thrust out and the egg was placed on a leaf or twig in the midst of or near the colony of the host insect. It was noticed that certain bushes shaded from the sun after 1.30 p. m. were immediately deserted by these flies until the next day.

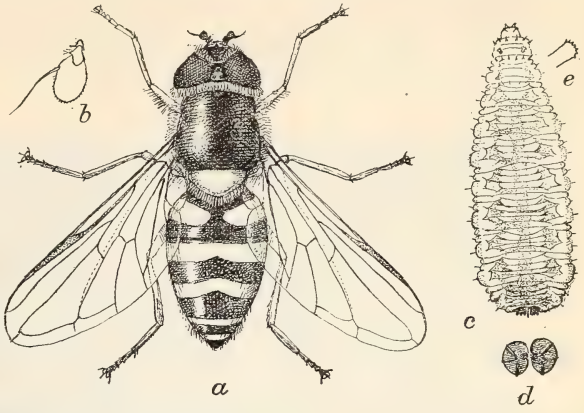

FIG. 3.—*Syrphus ribesii*, an enemy of the rose aphis: *a*, Fly; *b*, lateral view of head; *c*, larva or active immature form; *d*, anal spiracles; *e*, thoracic spiracle of same. All much enlarged. (From Chittenden.)

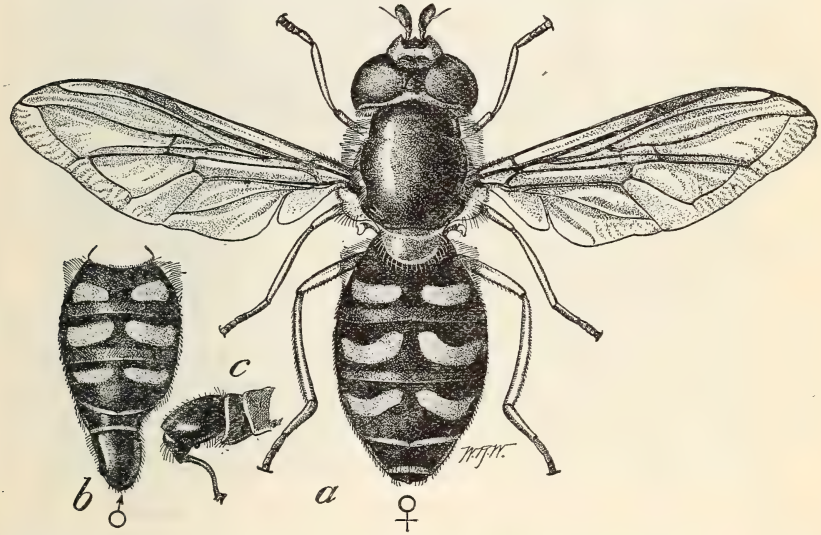

FIG. 4.—*Eupeodes volucris*, an enemy of the rose aphis: *a*, Female fly; *b*, abdomen of male fly; *c*, hypopygium of male fly. Much enlarged. (From Webster and Phillips.)

The rearing of five different species of syrphus flies from larvæ found feeding on the rose aphis rather surprised the writer, and he regrets that lack of time has prevented a continuation of the work

that it might be ascertained if other species would also be commonly reared.

Although the ladybird *Hippodamia ambigua* Lec. was observed during the entire time occupied by the observations on the rose aphis, it occurred in small numbers, and on only one or two occasions did it seem to be feeding on *Macrosiphum rosæ*.

DISEASE.

On March 14, 1910, after a night of rain, one winged and two wingless aphides were found enlarged to fully five times their regular size, as if bloated. This was probably due to a fungous disease.

EXPERIMENTS WITH REMEDIES.

The abundance of the rose aphis is so marked in many years that frequently almost daily complaints of damage are made in the District of Columbia and vicinity. Wherever it has been convenient or desirable to eradicate this species on small acreages of plants, water, applied with a garden hose or syringe, has been the remedy employed, not alone by the writer but by many persons resident in Washington. Indeed this treatment, which consists in directing a forcible stream of water against the affected portions of the plants has been one of the standard remedies advised. Experiments have been made by Dr. F. H. Chittenden, by Mr. C. H. Popenoe, and by Mr. A. B. Duckett, all in the District of Columbia and vicinity. In other regions, Mr. W. B. Parker has undertaken experiments with nicotine sulphate, and the writer has conducted quite a series of experiments with the same compound. Among other compounds used by Messrs. Chittenden and Popenoe for this species are aphis punk and other nicotine papers, always with gratifying success. While treating other forms of insects on roses, such as "slugs" and thrips, the aphides were always the first to perish.

EXPERIMENTS IN THE DISTRICT OF COLUMBIA AND VICINITY. [1]

On March 28, 1913, at Washington, D. C., four rosebushes in the greenhouse, well infested by the rose aphis, were sprayed with "black-leaf 40," a preparation guaranteed to contain 40 per cent of nicotine sulphate, in combination with whale-oil soap in the following formula:

Nicotine sulphate	ounce..	½
Whale-oil soap	pound..	½
Water	gallons..	2½

Although the solution slightly injured the terminal buds and the tender shoots, the results were all that could be expected, 100 per cent of the aphides being killed. It is believed that the solution could have been reduced 25 per cent in strength with equally good results.

[1] By A. B. Duckett.

SPRAYING ROSE BUSH WITH COMPRESSED-AIR SPRAYER BY HAND.

On April 23, at a Virginia station near Washington, a number of large rosebushes trained on the side of a house and well infested with aphides were sprayed. Both winged and wingless forms of aphides were present. Nicotine sulphate was applied, with and without the use of soap as in the previous formula, at the rate of 1 part to 1,000 of water. In the experiments without the use of soap some difficulty was found in obtaining a spreading action of the spray, and consequently only about 90 per cent of the aphides were reached. It is believed that all reached by the spray were killed. When nicotine sulphate was used at the rate of 1 part to 1,400 parts of water and 1 part to 1,500 parts of water, results were not satisfactory, only about 25 and 10 per cent, respectively, being destroyed. With the use of soap 100 per cent of the aphides on the vines were killed, the results being very satisfactory. At the rate of 1 part of nicotine sulphate to 1,400 of water with a laundry soap added, 90 per cent of the aphides were killed; whereas the results with nicotine sulphate at 1 part to 1,600 of water and 1 part to 1,800 of water in combination with soap were unsatisfactory, only 70 per cent and 50 per cent being killed.

In these experiments a compressed-air sprayer with Bordeaux type of nozzle was used at an estimated pressure of 90 pounds, and a fine but driving spray was employed. The water used for the dilution of the insecticide was particularly soft, but contained a very small proportion of sulphur.

From these experiments it may be concluded that nicotine sulphate at the higher dilutions as used in these experiments is much more effective against the rose aphis when used in combination with whale-oil or other soaps, since the spreading action thus induced is much more favorable. The plants may, however, be injured in case the spray solution is too strong. It is not believed that the injury shown in the experiments was caused by nicotine sulphate used at too great a strength, since it has been applied experimentally to roses in the greenhouse at the rate of 1 part nicotine sulphate to 15 parts of water without injury other than the appearance of mildew, undoubtedly superinduced by the spraying. It is apparent from the results obtained that a spray can not be employed weaker than 1 part of 40 per cent nicotine sulphate to 1,400 parts of water with satisfactory results unless in combination with whale-oil or other soap.

ARTIFICIAL CONTROL IN THE GARDEN.

Experiments have been conducted against the rose aphis with different nicotine extracts under different conditions as to strength and weather. In no case, in the writer's experience, were the plants injured, whereas the insect was destroyed in enormous numbers. The aphis is easily controlled by spraying with nicotine solutions

containing 40 per cent of nicotine at the rate of 1 part of the solution to from 1,000 to 2,000 parts of water, with whale-oil soap at the rate of 1 pound to 50 gallons of spray mixture. When only a few rose bushes require treatment the spray may be prepared in small amounts as follows: To 1 teaspoonful of 40 per cent nicotine solution add 1 to 2 gallons of water and one-half ounce of whale-oil soap. The soap should be shaved fine and dissolved in hot water.

There are on the market numbers of solutions containing less nicotine than the foregoing which may be used with good results with the addition of whale-oil soap, as advised, at the strength recommended by the manufacturers. If these are not obtainable, very good results may be accomplished by dissolving 1 pound of whale-oil soap or 2 pounds of common laundry soap in from 4 to 6 gallons of water. Wherever possible, however, the nicotine solutions should be used, as better results will be obtained.

This species, like practically all of the green aphides, can also be controlled by repeated applications of a forcible stream of cold water. Since the roses in California and some other localities are much subject to mildew, repeated use of this method has the disadvantage of increasing injury by this disease. In the case of the appearance of mildew, however, either through syringing with water or through the application of nicotine sulphate, this disease may be readily controlled by adding to the nicotine sulphate solution copper sulphate or blue vitriol at the rate of 1 pound to 50 gallons of water (approximately 1 ounce to 3 gallons). A solution of copper sulphate used at this strength and sprayed on the plants after the application of the water treatment is effective in controlling the mildew. Another common practice of florists for the prevention of mildew is to dust the plants immediately after sprinkling or watering with common flowers of sulphur.

In order successfully to fight this insect these sprays should be applied with a compressed-air sprayer (Pl. III) or bucket pump capable of creating a fine penetrating spray. These pumps can usually be purchased at the seed stores at from $3.50 up to $15. The nicotine solutions are also carried by most seed stores. Where a pump is not to be obtained much can be accomplished by dipping the infested twigs into a pail of the solution of nicotine.

From the experiments of the writer it is evident that this insect can be destroyed easily by the use of nicotine solutions of considerably less strength than have heretofore been used, but the treatment must be repeated at intervals to kill the aphides missed by former applications. With the different styles of pumps now on the market at low prices no one who cares for roses has the slightest excuse for allowing them to be injured by this insect.

TREATMENT IN THE GREENHOUSE.

For the treatment of the rose aphis as it occurs in greenhouses the nicotine solutions may be used, but at a lower strength than advised in the preceding paragraphs. Conditions vary somewhat, but it is believed that in most cases if the nicotine solution is used at the strength of 1 part to 2,000 of water it will not injure the rose plants if applied on a dark day or late in the afternoon so that the plants will not be exposed to reflected sunlight through the glass.

When greenhouses containing different forms of plants are syringed with a forcible stream of water or with neutral soaps of the castile or similar types for the red spider and other insects, the rose aphis and other green aphides will also be killed. The same is true in regard to fumigations with hydrocyanic-acid gas for other rose pests. Directions for the use of hydrocyanic-acid gas for the fumigation of greenhouses and cold frames are given in Circular No. 37 of the Bureau of Entomology. In the experience of Dr. A. F. Woods, the author of that publication, the young growth of roses is particularly sensitive and has been more or less injured in experiments in the use of this gas. This is particularly true of such varieties as "Perle des jardins," "Mermet," and "Bride."

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